Sustainable Management Practices to Mitigate Oil Spillage on Seashore Andcoastal Areas

M. Barani
Ph. D Research Scholar, Professor
Department of Economics, Periyar University, Salem, Tamil Nadu, India

D. Janagam
Ph. D Research Scholar, Professor
Department of Economics, Periyar University, Salem, Tamil Nadu, India

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Abstract
Oil spills pose serious environmental, economic, and public health challenges, particularly in coastal regions where communities rely on marine resources for their livelihoods. This study examines the impact of an oil spill affecting the coastal settlements of Kattukuppam, Thazhangup-pam, Chinnakuppam, EnnoreKuppam, and MugathwaraKuppam in North Chennai. A sample of fishing-dependent households was surveyed to assess the extent of environmental disruption and community-level impacts resulting from oil spills. The findings indicate that the affected population experienced noticeable health complaints, including respiratory discomfort, skin irritation, headaches, fatigue, and eye irritation, primarily due to exposure to contaminated seawater, crude oil residue, chemical dispersants, and fumes. Beyond health impacts, the oil spill significantly affected livelihood activities, particularly fishing and related income-generating occupations, leading to reduced income stability and altered household expenditure patterns. Overall, the results reveal strong interconnections between environmental degradation, public health concerns, and socio-economic vulnerability in coastal communities affected by oil spills. These findings emphasise the need for effective emergency preparedness, community-level health monitoring, compensation frameworks, and sustainable spill response systems. Future research should explore improved prevention strategies and advanced response technologies to manage, reduce, and prevent oil spills while assessing long-term environmental, socioeconomic, and health outcomes.

Keywords: Oil Spill, Health Impacts, Coastal Communities, Oil Pollution Control, Environmental Sensitivity Index, Spill Management and Techniques, Marine Ecosystems

Introduction

The worldwide use and distribution of crude oil and its derivatives continues toimpose a potential threat to aquatic environments. Accidental releases can occur from a variety of sources, including tankers, pipelines, storage tanks, refineries, drilling rigs, wells, and platforms (Vanem et al., 2008). Fortunately, spill frequency and volume from all international sources have decreased since the 1970s (Burgherr, 2006) owing to the identification of management-based risk factors (Bergh et al., 2013), increasing implementation of preventive regulations, and the development of corporate social responsibility practices by the oil production and transportation industries (Rauffleta et al., 2014). Despite these global improvements, there may be an increased risk of spills at the local level due to increased industrial activities in countries with high economic growth, such as in the South China Sea (Woolgar, 2008).

Additionally, catastrophic spills remain a possibility from all sources. The inability of responders to prevent spilled oil from reaching sensitive areas leads to economic, social, and environmental damage. These large-scale spills in highly mobile aquaticenvironments highlight the need for remediation technologies that can respond swiftly tomitigate potential damages.

Research Gap

Although several national and international studies have examined oil spills in terms of environmental degradation, marine ecology, and cleanup mechanisms, limited empirical evidence exists on how oil spills directly affect human health and livelihood patterns in small-scale coastal settlements like Cayo de Agua. In Tamil Nadu, particularly in the Ennore coastal stretch, there is a lack of micro-level assessments documenting the real-time physical symptoms experienced by vulnerable fishing households and the socio-economic disruptions that follow spill events. Existing literature does not sufficiently address the community-level consequences and lived experiences of fishing-dependent populations exposed to oil contamination.

Problem Statement

Despite efforts to prevent and manage oil spills, accidental releases continue to occur in coastal industrial and maritime regions such as Kattukuppam, Thazhanguppam, Chinnakuppam, EnnoreKuppam, and MugathwaraKuppam. These incidents have adversely affected marine resources, fishing activities, and the well-being of communities that depend on them. However, there is insufficient documented evidence on the extent to which oil spills have caused health disorders, income loss, and livelihood disruptions among the coastal population. The absence of localised impact assessments limits the development of appropriate mitigation and support mechanisms for these communities.

Review of Literature

Alesia Ferguson et al. (2020) focused on describing a method for evaluating the impacts of oil spill chemicals (OSC) on human physical health following exposure. This paper begins by describing research programs that address oil spills and the literature supporting the need to address human health risks. A methodological approach for determining health risks is then described in detail including the need to evaluate chemical concentration distributions, human activity patterns, and chemical toxicological profiles. Importantly, data gaps are described for this methodological approach in the context of developing a health risk modelling platform for future oil spills. Since health risks from oil spills are both physical and mental and are sometimes intertwined, the complexity of these interactions is briefly mentioned, along with the challenges in communicating risks to communities given uncertainties and variabilities in the exposures and outcomes.

C.F. Santos and F. Andrade (2022)The main objective of the present work is to identify the best coastal sensitivity assessment approach for Portugal, in the scope of an oil spill event. Two different methods are compared: sensitivity maps and algorithm-based sensitivity models. The development process and potential for the use of these approaches in the Portuguese context are considered and discussed. Although both approaches are viable to assess coastal sensitivity and the corresponding protection priorities, the proven feasibility and effectiveness of sensitivity maps grant them an operational advantage. Considering all the discussed aspects, and although not assuming the character of a deterministic conclusion, the development and use of sensitivity maps (with their proven feasibility and effectiveness) appears to be potentially more effective for the assessment of the Portuguese coastal sensitivity.

Theoretical Background

Ecological theory has traditionally emphasised equilibrium community states and the development of criteria for exclusion and indefinite persistence in these states. However, exclusion occurs over a timescale. If this is long, communities may exhibit transient dynamics and be far from equilibrium. This is particularly likely when considering interactions among species which are very similar in their niche requirements and environmental effects; their abundances can vary over time in an essentially random fashion. An important task for future ecological theory and empirical work is to derive a deeper understanding of transient dynamics and drift hypothesis.

Objectives

1. To study about the onshore and offshore impacts of oil spillage in study areas.
2. To examine identify the oil spill clean-up techniques.

Methodology

The study employs both primary and secondary data. Primary data were collected using a structured questionnaire administered to fishing-dependent households in the affected coastal settlements. A total of 70 respondents were selected using purposive sampling to assess the oil spill's environmental, health, and livelihood impacts on the community. Secondary data were obtained from multiple government and research institutions, including the Chennai Port Authority, Tamil Nadu Pollution Control Board, Central Marine Fisheries Research Institute, National Institute of Ocean Technology, Department of Fisheries, and relevant project reports from the Department of Development Studies. These sources were used to complement field findings, provide contextual evidence, and validate the observed impacts.

Impacts in Onshore and Offshore Environmental Damage of Oil Spill

The coastal villages of Kattukuppam, Thazhanguppam, Chinnakuppam, EnnoreKuppam, and MugathwaraKuppam have been severely affected by oil spill incidents, primarily originating from offshore and onshore activities such as oil trafficking, accidental releases, tank washing, and marine drilling operations. These sources contribute significantly to oil pollution on the coastline. Oil spills result in multiple forms of damage including environmental degradation, ecological imbalance, loss of marine biodiversity, disruption of commercial fishing, tourism decline, and adverse impacts on coastal wildlife. If spilled oil remains on the shoreline, it accelerates habitat destruction and long-term soil and water contamination. The scale and severity of coastal impacts depend on geographical characteristics, biodiversity, weather conditions, environmental sensitivity, and socio-economic dependence of affected communities. Highly populated coastal areas with dense marine traffic, offshore drilling platforms, and vulnerable ecosystems such as mangroves and wetlands are at greater risk (Dwarakish et al., 2009).

Oil spills directly affect marine flora and fauna, damaging seabirds, mammals, fish, and benthic species by coating their fur, feathers, or gills. This exposure may cause suffocation, poisoning, reproductive failure, disease, and mortality. In addition, coastal physical structures—including seawalls, breakwaters, groynes, and jetties—may intensify or alter spill movement, affecting surrounding habitats. The socio-economic consequences are equally severe, as fishing activities decline, marine product sales drop, and tourism-based income diminishes, leading to economic instability among local communities. Human exposure to oil contamination and fumes may cause respiratory issues, skin irritation, nausea, headaches, and long-term health complications.

The study included 70 respondents from five oil-spill–affected coastal villages: Kattukuppam, Thazhanguppam, Chinnakuppam, EnnoreKuppam, and MugathwaraKuppam. The sample consisted of individuals from fishing-dependent households, including fishers, fish vendors, net repairers, and shell collectors. Most respondents belonged to traditional marine-based families with long-standing occupational dependence on coastal resources. Health responses were collected based on the symptoms experienced after exposure to oil spills. The results indicated that most respondents reported health problems following the incident. Respiratory issues were the most common symptom reported, followed by skin irritation, eye irritation, and general discomfort such as headaches, nausea, and fatigue. Only a small portion of respondents reported no noticeable symptoms. Vulnerable groups such as children, elderly persons, pregnant women, and women involved in fish handling and vending experienced symptoms more frequently and more severely.

Table 1 Types of Health Impacts Study Areas

Health Condition	Frequency (n=70)	Percentage (%)
Respiratory issues	48	68.57
Skin irritation	42	60.00%
Eye irritation	36	51.43%
Headache/ Nausea/Fatigue	33	47.14%
No symptoms reported	8	11.43%

The oil spill significantly disrupted livelihood patterns across the affected communities. Among the 70 respondents, 46 individuals who were fully dependent on marine occupations such as fishing, net making, and fish vending experienced the greatest income loss, as their work stopped completely during the contamination period. These households relied solely on daily marine harvest and therefore faced severe financial strain when fishing activities were restricted and market demand declined. In contrast, 24 respondents shifted to temporary or alternative income sources, including grocery shops, construction work, mechanised labour, and small services such as auto-driving or fish cleaning for external markets. While these alternative occupations helped reduce the financial burden, the income earned was significantly lower than their usual fishing-based earnings. Overall, the spill caused a noticeable reduction in livelihood security, forcing households to adjust spending on essential needs such as food, fuel, healthcare, and education, while some reported dependency on loans or assistance to manage daily living costs.

Table 2 Income Loss Categories Among Respondent

Income_loss_ Group	Frequency	Percent
1 (High Loss)	46	65.71%
2 (Moderate Loss)	24	34.29%
Total	7	100%

The descriptive results indicate that most respondents experienced a high level of income loss following the oil spill. Out of the 70 respondents, 65.71% fell into the high-loss category, meaning they were fully dependent on fishing activities and therefore faced the greatest financial impact. In contrast, 34.29% of respondents reported moderate income loss, as they were able to temporarily shift to alternative work sources such as shop work, construction, or other labor activities during the spill period.

This distribution shows that fishing-dependent households are more economically vulnerable than those with access to alternative income opportunities. The imbalance highlights the strong occupational dependency on marine-related livelihoods in the study area and demonstrates how environmental disruptions directly affect income stability and economic security among coastal communities.

Table 3 Area-wise Distribution of Reported Health Impacts

Study Area	High Symptoms Reported (Respiratory, Skin, Eye, Headache	Mild Symptoms	No Symptoms	Overall Impact Level
Kattukuppam	14	2	1	High
Thazhanguppam	12	2	1	High
Chinnakuppam	10	2	1	Moderate–High
EnnoreKuppam	9	2	2	Moderate
MugathwaraKuppam	8	3	3	Moderate

The distribution of health symptoms across the five study areas showed variations in exposure severity and impact levels. Kattukuppam and Thazhanguppam recorded the highest number of respondents reporting severe health symptoms, indicating greater exposure to oil contamination and proximity to the spill location. Chinnakuppam displayed a moderate–high level of symptoms, suggesting noticeable but slightly lower exposure than the first two villages.

In EnnoreKuppam and MugathwaraKuppam, a higher number of respondents reported mild symptoms or no symptoms, resulting in a moderate overall impact level. The presence of respondents without reported symptoms in these areas suggests relatively reduced exposure, possibly due to distance from the spill, differences in shoreline activity, or lesser reliance on direct contact with contaminated marine resources.

Oil Spill Cleaning Methods / Shoreline equipment, Supplies and Services

Burning - The process of burning removes large portions of oil from the water's surface, keeping it away from the shoreline.

Booms: To contain/deflect slicks, localise the spill, and minimise pollution. Facilitates oil removal by causing it to concentrate in thicker layers on the surface. The containment of an oil spill relies on the efficient use of booms under suitable sea conditions. Skimmers - Once oil has been contained by a boom, it is essential that recovery of collected oil be undertaken as soon as possible. This is typically performed using skimmers. The nominal picks up rate is seldom maintained due to the difficulty of keeping skimmers in the thickest oil.

Storage -Temporary storage system is required for oil, which is recovered by skimming devices from within containment booms. Most vessels and recovery devices do not incorporate any significant storage capacity and sea storage system musbe provide by a towed barge, floating storage tanks or collapsible tanks.

Dispersants - Dispersants act to 'break-up' surface slicks and result in oil becoming mixed into the upper layers of water.

Biological Agents - Biological agents Microorganisms can assist with accelerating the biodegradation of oil - especially along shorelines. Clean-up crews can. Biological agents increase the rate at which oil naturally biodegrades. During this process, known as bioremediation, chemical agents, Chemical Dispersants - Use of chemical and biological methods for cleaning up oil spills increases the oil's natural chemical or biological degradation processes. Use of chemical and biological methods for the cleaning up of oil spills increases the oil's natural chemical or biological degradation processes. Sorbents - Synthetic sorbents are similar to plastics and are designed to soak up liquids into their surface and can absorb liquids into their solid structures. These specialised materials, which can take forms such as square pads or long booms, are engineered to absorb oil but not water.

Manual Recovery - This method involves using good old buckets, shovels, rakes, and other hand tools to remove oil from shorelines. It is very labour-intensive.

Bioremediation -Bioremediation is the last method of oil spill clean-up. It is based on the use of specific microorganisms released to the water, Oil exploration, production and transportation at sea present a risk of accidental oil spills. Oil exploration in the Arctic may present serious environmental hazards if a major oil spill occurs, particularly if the oil spill coincides with the occurrence of ecologically important and vulnerable species in the ice or at the coast. However, because the impact of a spill depends on numerous more or less unpredictable events, which interact in a complex fashion, a high degree of uncertainty in assessing the potential impact of an oil spill is inevitable.

Based on the findings of this study, there is significant scope for further research on oil spill management in coastal regions. At present, oil spill response in Tamil Nadu primarily relies on basic cleanup practices with limited use of advanced technologies. Future research could therefore explore the effectiveness, cost efficiency, and environmental safety of emerging technologies such as:

- Special absorbent sponges and advanced oil-binding materials
- Autonomous robotic oil recovery systems
- Magnetic soap and nano-based oil separation techniques

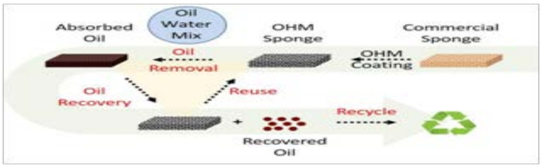
Additionally, future studies may adopt longitudinal research designs to assess the long-term environmental, health, and socioeconomic effects of oil spills on coastal communities. Such research would provide a stronger scientific basis for improving disaster preparedness, response mechanisms, and policy interventions in oil spill management.

Suitable methods for Oil spill in coastline areas in Tamil Nadu

New Innovative machines - Special sponges

Special sponges used in oil spill response are advanced absorbent materials specifically engineered to attract and retain oil while repelling water. These sponges have hydrophobic and oleophilic properties, meaning they do not absorb water but selectively absorb oil from contaminated surfaces or water bodies. They are often made from polyurethane foams or coated with nanomaterials such as graphene or carbon nanotubes to enhance their absorption capacity. Some variants are designed with magnetic properties, allowing easy recovery after use. These sponges can absorb several times their own weight in oil and can be reused multiple times by squeezing or thermal treatment. Due to their high efficiency, selective absorption, and eco-friendly functioning, special sponges are considered a promising modern technology for improving oil spill cleanup and restoring affected marine and coastal environments.

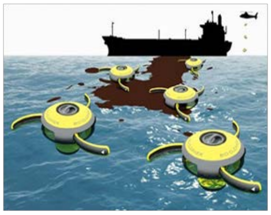
Special Sponges



Autonomous Robots

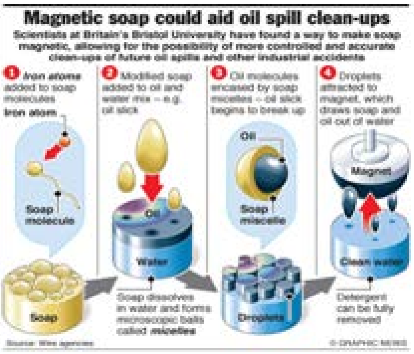
Autonomous robots are an advanced technological solution for oil spill detection, monitoring, and cleanup in marine environments. These robots operate without continuous human intervention and are equipped with sensors, cameras, and artificial intelligence systems that enable them to identify oil layers, map contamination spread, and carry out targeted cleanup operations with precision. Some models are designed to skim oil from the water surface, whereas others deploy absorbent materials or collect oil using mechanical suction. Their ability to operate continuously, even in hazardous or hard-to-reach areas, makes them highly effective during emergency response situations. For coastal regions like Tamil Nadu, where frequent marine traffic and industrial activity elevate spill risk, autonomous robots could significantly enhance response speed, reduce human exposure to toxic environments, and improve the overall efficiency of spill management. Integrating such robotic systems into coastal disaster preparedness frameworks can contribute to faster ecosystem restoration and better protection of coastal livelihoods

Autonomous Robots



Magnetic Soap

Magnetic soap is an innovative material developed for oil spill cleanup by chemically modifying standard soap molecules to include iron-based particles that impart magnetic properties. These engineered molecules retain their natural detergent behaviour, attracting oil while repelling water. When applied to an oil spill, the magnetic soap attaches to the oil droplets and breaks them into smaller particles, forming a magnetically responsive oil–soap mixture. This mixture can then be efficiently collected using external magnets placed on or below the water surface, allowing precise oil removal without relying on harmful chemical dispersants or intensive manual cleanup. Because this method separates oil from seawater without disturbing sediment, marine organisms, or ecological balance, magnetic soap offers a more sustainable, environmentally friendly, and highly efficient approach to spill response. For coastal regions such as Tamil Nadu—where industrial activities, ports, and marine traffic increase spill risks—magnetic soap presents a promising future technology for faster, cleaner, and more effective oil spill management to protect marine ecosystems and coastal livelihoods.



Riskand Spill Assessment

Hazard Rating: National Fire Protection Association (NFPA) has accorded rating with respect to degree of hazard posed by chemicals being handled in port. The rating is in numbers with respect to flammability (NF), health hazard (Nh) and reactivity (Nr). The rating of hydrocarbons (high number being more hazardous) are as per table 1.1.

Table 4 Hazard Ratings

Product	Nf	Nh	Nr
High speed diesel	2	0	0
Crude oil	3	1	0
Gas oil	2	0	0
SKO	2	0	0
Naphtha	3	1	0
Motor spirit	3	1	0

Flammability (Nf) 3 - Liquids and solids that can be ignited under almost all ambient temperature conditions. 2 – Materials that must be moderately heated or exposed to relatively high ambient temperature before ignition can occur Health (Nh) 0 – Materials which on exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials. 1 – Materials which on exposure would cause irritation but only more residual injury if no treatment is given. Reactivity (Nr) 0 – Materials which in themselves are normally stable, even under fire exposure conditions and which are not reactive with water. It is apparent that risks to human life in terms of flammability, health and reactivity are not very significant and can be handled with some degree of expertise.

Environmental Senility

The importance of the area both ecologically and socioeconomically is taken into account. Areas such as coral reefs, mangroves, fish nursery areas, bird and turtle breeding areas are ecologically important. At times these areas are also socio-economically important. Other areas such as beaches and other facilities being recreational areas are also important and also provide revenue to the community.

Environmental Sensitivity Index Mapping

Environmental sensitivity index (ESI) maps provide a summary of coastal resources that are at risk if an oil spill occurs in the vicinity. Examples of at-risk resources include birds, shellfish beds, sensitive shorelines (such as coral reefs), and public beaches and parks.

Shorelines are color-coded to show their sensitivity to oil. Warm colours indicate the most sensitive shorelines, and cool colours indicate fewer sensitive shorelines. Large habitat areas (such as tidal flats and wetlands) are shown as polygons filled with a pattern of appropriate colour. Symbols mark locations important to spill responders, such as areas where birds or sea mammals congregate or breed, areas where different kinds of birds concentrate for feeding or nesting, and areas used by people.

Shoreline Sensitivity

There is a high concentration of different kinds of sensitive zones to be protected or accorded priority; these zones fall under different classifications: ecological, agricultural, fishing, industry, tourist, and recreational.

Onshore/ Offshore Mitigate

Management response actions are required to be initiated by responders at the first notice or information about the Oil spill. While the availability of different parameters that affect a spill as compiled into this plan is beneficial, further acquisition of data can take place concurrently with the launch of response operations.

Major actions that would be taken when a spill occurs are mentioned below. While some actions like containment, are required to be initiated immediately following a spill, others, like shoreline clean-up, etc., will be initiated in due time. The purpose of a fast response is to minimize hazards to human health and the environment. The following responses are accordingly addressed through the Contingency Plan and Operations Manual:

- Stoppage of discharge and containing spills within a limited area.
- Defining the size, position and content of spills, the direction and speed of movement, and the likelihood of affecting sensitive habitats.
- Notification to private companies or government agencies responsible for cleanup actions.
- Movement of trained personnel and equipment to the site.
- Initiation of response activity.
- Ensuring the safety of response personnel and the public.

Oil removal and disposal. Application is to be dictated as per the procedures, calculations, and methodologies recommended by the Operations Manual. List of dispersants approved by the Coast Guard for application.

Coastal and Shoreline Cleanup

The coastal stretches off Mumbai harbour are varied in terms of ecological sensitivity, with large stretches of mangroves ecological sensitivity; with sandy beaches and rocky shores. The Mumbai estuary shows differences in the physical environment, the degree of exposure to waves, energy levels, and currents. Geomorphic features like the terrain greatly influence the distribution and persistence of oil.

While the first priority would be to stop the ingress of oil onto the coast, the requirement of coastal or beach cleaning operations cannot be ruled out. The local administration, being responsible for shore cleaning activity, is to be notified in time about the movement of spills and advised about the strategy to be adopted.

Tactical beach cleaning operations are to be conducted as per the physical properties of the terrain with respect to the retention of oil. Operations must follow the parameters outlined in the

Operational Manual

The typical response equipment required for mounting an operation consists of equipment for water response and shoreline operations and could include:

Table 4 Revamping of Onshore / Off shore

Offshore	Shoreline
Booms	Shovels
Skimmers	Diggers/loaders
Absorbents	Drums / skips
Sprayers & dispersants	Trucks/tankers
Radio communication	Plastic sheeting
Boats / tugs / response vessel	Protective clothing
Pumps / hoses	Communications
Tanks/ barges/storage	Control room
Aircraft	Transportation

The equipment required for response in terms of containment, maintained on the vessel, will be the first to be deployed for containment and would be augmented by the movement of additional equipment as required by the situation.

Shoreline Operations

Table 5 Major functions of Crisis Management Team

The major functions that would need to be carried out by CMT to discharge the Plan

Field ops	Initiation, Control of Operations and Response activity the emergency control room functions. Implementing tired response and disposal Shoreline cleaning (when initiated through this CP) Planning and strategy.
Admin and logistics	Victims, Transport, Additional Manpower and Equipment, and Security.

Technical matters	Cargo operations, availability of response items, repairs.
Liaison	Communication - operational and with other government or non-government authorities, media.
Legal	Documentation of damages, claims, and compensation, notifications.
Health and safety	Medical Assistance.

Major Functions of Crisis Management Team

Shoreline operations will be undertaken by local civil authorities according to their contingency plans. Taking into account the spill movement and area sensitivity, the equipment will be mobilized along with manpower to the site by the local administrative authority. The procedures laid down in the Operations Manual will be available for reference to clean-up teams, along with the expertise held by responders.

Summarized

The study involved 70 respondents across the affected coastal villages, and the results indicated that the oil spill led to widespread health impacts, with most respondents reporting symptoms such as respiratory distress, skin irritation, eye discomfort, and general fatigue. The spill also caused noticeable livelihood disruption, with fishing-dependent households experiencing considerable income loss, while a portion of respondents temporarily shifted to alternative occupations to manage economic pressures.

Results from the Study

The study conducted among 70 respondents from the coastal villages of Kattukuppam, Thazhanguppam, Chinnakuppam, EnnoreKuppam, and MugathwaraKuppam revealed noticeable health impacts following the oil spill. Most respondents reported symptoms such as respiratory discomfort, skin irritation, eye irritation, headaches, fatigue, and nausea, while only a few reported no symptoms. The findings show that health effects were widespread and more severe among individuals who were frequently exposed to contaminated seawater, polluted air, and oil residue during daily activities.

The results also indicate a clear disruption in income and livelihood security. Households entirely dependent on fishing experienced significant income loss due to the temporary halt in fishing activities and reduced market demand for seafood. In contrast, a smaller portion of respondents shifted to temporary alternative employment, such as construction work or small service-based jobs, to manage economic challenges. Overall, the study confirms that the oil spill resulted in both health-related risks and noticeable livelihood losses among the affected coastal communities

Justification of the Study

Oil spills have become an increasing concern in coastal regions of Tamil Nadu due to growing industrial activity, maritime traffic, and inadequate disaster preparedness. Despite multiple reported spills, there is limited empirical research on their direct impacts on the health, livelihood, and environment of affected communities. The affected coastal settlements rely heavily on fishing, making them economically vulnerable to the disruptions caused by marine pollution. This study is justified because it provides evidence-based insights that can support policy development, improve response strategies, strengthen coastal governance, and protect vulnerable populations from future spill-related risks.

This study is essential because the affected coastal communities across Kattukuppam, Thazhanguppam, Chinnakuppam, EnnoreKuppam, and MugathwaraKuppam are highly dependent on marine resources for their livelihood, food security, and cultural continuity. Oil spill incidents in these regions have resulted in visible environmental degradation; however, there is limited documented evidence on how such events directly influence human health and household economies. Existing research in India largely focuses on environmental and ecological damage, while social, economic, and public health dimensions remain understudied, especially at the community level.

Coastal settlements face recurring industrial pollution and lack strong spill-response mechanisms or healthcare support systems. Therefore, there is an urgent need to generate empirical data that captures the lived experiences of affected populations. The findings from this study will contribute to informed policy decisions, improved environmental planning, strengthened disaster preparedness, and the development of targeted intervention strategies to protect vulnerable fishing households from future oil spill incidents.

Conclusion

This study examined the environmental, health, and livelihood impacts of the oil spill affecting the coastal communities of Kattukuppam, Thazhanguppam, Chinnakuppam, EnnoreKuppam, and MugathwaraKuppam. Findings from the survey of respondents show clear evidence of exposure-related health symptoms, with respiratory difficulties, skin irritation, eye discomfort, headaches, and fatigue being the most commonly reported issues. The results also indicate significant livelihood disruption, especially among those fully dependent on marine fishing, where income loss was substantial due to reduced fish availability, contamination fears, and declining market demand. Respondents who temporarily shifted to alternative employment still experienced financial instability, demonstrating the spill's broad socio-economic impact.

The results align with the objectives of the study by documenting the extent of health risks and livelihood losses faced by affected communities and identifying the need for improved response and preparedness mechanisms. The findings highlight the urgent necessity for stronger oil spill management practices, stricter environmental monitoring, and community-based disaster response systems. Policy intervention is essential to protect vulnerable populations, ensure compensation mechanisms, improve occupational safety, and establish long-term coastal restoration strategies. Future research should incorporate clinical health assessments and longitudinal socio-economic tracking to better understand prolonged effects and resilience-building pathways.

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Handbook of Oil Spill Science and Technology" – Mervin Fingas

Introduction to Oil Spill Response and Clean-Up" – Paul F. Hill

Marine Pollution: What Everyone Needs to Know" – Judith S. Weis

Oil Spill Science and Technology – Mervin Fingas (2016)

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Introduction to Oil Spill Response and Clean-Up – Paul F. Hill

Marine Pollution: What Everyone Needs to Know – Judith S. Weis

Oil Pollution and the Marine Environment – J. W. Doerffer

*Environmental Pollution and Coastal Ecosystem*s – R. K. Trivedy

Author Details:

M. Barani, *Ph. D Research Scholar, Professor, Department of Economics, Periyar University, Salem, Tamil Nadu, India*

D. Janagam, *Ph. D Research Scholar, Professor, Department of Economics, Periyar University, Salem, Tamil Nadu, India*